

First complete map of world's seagrass offers warnings and hope for conservation

Seagrass is an underwater 'rainforest' that protects marine life, coastal communities and their economies, and our climate

By Mikala Kass, ASU News
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It's time we gave seagrass the credit it's due.

This hero of a plant protects coastlines, stores vast amounts of carbon, and supports ecosystems that people and wildlife depend on. But we don't often hear about it when it comes to ocean conservation. That's partly because we knew so little about it — until now.

For the first time, scientists have unveiled a high-resolution global map of seagrass, as well as data on how seagrass coverage changed over a four-year period. More than just a map, the information brings invaluable insights that will transform the methods and policies used to manage seagrass ecosystems worldwide.

Arizona State University's [Center for Global Discovery and Conservation Science](#) led the study, [published today in Nature](#). While the data shows a loss of 1% per year during the four years covered in the paper, it also reveals areas that achieved seagrass recovery, creating a blueprint for further restoration efforts. And knowing exactly where these precious ecosystems are unlocks the potential for more targeted conservation.

The center is part of the [Julie Ann Wrigley Global Futures Laboratory](#).

"This work represents a game change in global coastal ecosystem monitoring, addressing a long-standing gap in marine science: the lack of accurate, consistent and high-resolution global maps of seagrass," says lead author [Jiwei Li](#), an assistant professor in the [School of Ocean Futures](#). "Previous estimates varied widely due to inconsistent methods and sparse data, limiting their use in science and policy."

The rainforest of the ocean

Seagrass is not the same as seaweed. Seaweed is a type of algae, but seagrass is a plant, with leaves, flowers, seeds and — perhaps most importantly — roots. These roots hold sediment together and protect coastlines from erosion.

By keeping sediment locked away, seagrass also helps store a lot of carbon. Seagrass itself stores carbon as it grows, and when it dies it's buried in more sediment that's held down by new layers of seagrass.

Based on their map and data from another study that measured the amount of carbon stored in the top 30 centimeters of sediment, the researchers estimate that seagrass ecosystems store approximately 640 teragrams. It's likely more, because ocean sediment can be much thicker than 30 centimeters in some places. (trillion grams) of carbon globally. In terms of CO₂, that's about the same as the yearly emissions of 500 million cars.

Besides acting as a carbon sink and protecting coastlines from damage, seagrass helps us in many other ways. It improves water quality by filtering pollutants. It supports a healthy marine ecosystem by providing food and shelter for lots of animals. That means it's also good for fisheries and for people who depend on the ocean to eat and make a living.

"When we're talking about seagrass, you can think about it as a rainforest underwater," Li says. "It's foundational for all the food webs in coastal regions."

A missing map

The [Allen Coral Atlas](#) project, led by the Center for Global Discovery and Conservation Science, is known for creating the [first global map of shallow-water coral reefs](#) and [other tracking tools](#) used to help protect coral reefs.

As scientists at the center attempted to add seagrass data to the coral maps, they realized that mapping seagrass is very different than mapping coral reefs. To give the world its first comprehensive map of seagrass ecosystems, they needed custom tools.

Li's team trained an AI model to detect seagrass in satellite images. Their work relied on collaborators from around the world doing research dives to confirm the presence of seagrass and other underwater features, including rock, coral, algae or sand. Each data point the divers confirmed was tagged with its coordinates.

Li took this "ground truth" and used it to teach and test the AI model when it was shown satellite images of those same coordinates. Once the model was trained, the team used it to analyze millions of satellite images and create the global seagrass map. ASU's supercomputer resources, including [global top performer Sol](#), were an important tool for this research.

"ASU has very good supercomputing support for us," Li says. "We used the Agave and Sol supercomputers at ASU to do all the deep learning work."

The model can detect if an area 10 meters square has seagrass and whether the seagrass is dense or sparse. Currently, the map can detect objects up to 30 meters deep because of limited satellite capabilities.

Most seagrass grows in water 30 meters deep or less, because it needs sunlight just like plants on land. However, some seagrasses grow in water up to 40 meters deep. In the future, hyperspectral satellites may be able to see at greater depths, allowing the team to capture deeper-growing seagrass.

“The seagrass map is being added to the Allen Coral Atlas coral reef maps and to our monitoring systems so that we can start to include these critical areas in plans, including marine protected area development, the carbon market, biodiversity conservation and even law enforcement,” says [Greg Asner](#), a co-author on the paper and director of the center. “But the real innovation is the fact that the seagrass map is systematically built for the whole planet.”

Losses, wins and hope

The researchers found that almost 70% of seagrass is concentrated off the coasts of just five countries: the U.S., the Bahamas, Cuba, Australia and Indonesia.

When they compared satellite data from 2019–2020 and 2023–2024, they discovered that roughly 4% of seagrass was lost over that time.

Much of that loss was associated with human activities, including coastal development in China and fertilizer pollution in Florida. Climate stressors may also play a part, like Hurricane Dorian in the Bahamas and a marine heat wave in Australia, but the researchers point out the need for data over longer time periods to make connections.

Damage to a seagrass ecosystem has consequences, including less attractive habitat for marine life, fewer food and income resources for people living near the coast, less storm-resistant coastlines and more greenhouse gases released. Thanks to this project, we now have a better idea of how much we stand to gain or lose.

“Before our mapping project, people did not know where seagrass is or the total extent of seagrass, so they could not calculate how much carbon it stores in the sediment. This is a big step forward for that,” Li says.

The team’s data suggests that using the map to create more strategic marine protected areas could be a powerful application. They found that only about 21% of seagrass is located inside marine protected areas, and nearly 80% of seagrass loss occurred outside marine protected areas.

They also found evidence of conservation methods that work. Seagrass increased in

What others are saying

“This landmark study of the global distribution of seagrasses offers the first comprehensive mapping of a vitally important and rare marine habitat. ... Critically, more than half of these (seagrass) beds are currently unprotected, identifying them as high-priority targets under the 30x30 framework of the Kunming-Montreal Global Biodiversity Framework,” says Eric Dinerstein, a prominent conservationist and the chief scientist and senior conservation counsel for [Conservation X Labs](#).

South Bay near Los Angeles, thanks to a restoration project, and in Cuba due to improved water clarity. The map will make it possible to see where future restoration efforts will have the biggest impact.

In more good news, seagrass grows quickly. Slow-growing coral can take decades to heal from damage, but seagrass can recover in much less time. Li says there's a need for studies on seagrass growth and recovery. This information could help guide seagrass management in the future.

Seagrass also supports coral reefs in some areas. A win for seagrass is also a win for struggling coral reefs.

"Ultimately, this study transforms seagrass from a poorly quantified ecosystem into a globally observable climate and conservation asset, enabling more transparent, data-driven decision-making for coastal management and climate mitigation," Li says.

The School of Ocean Futures is part of the [Rob Walton College of Global Futures](#) in the Global Futures Laboratory.

Florida International University; James Cook University; The Nature Conservancy, Caribbean Division; the University of New South Wales Sydney; and the University of Queensland contributed to this study.

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This story originally appeared on [ASU News](#).

¹ It's likely more, because ocean sediment can be much thicker than 30 centimeters in some places.

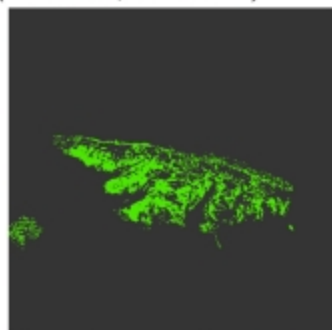
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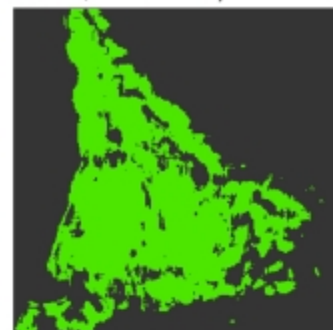
A satellite photo of Papua New Guinea with areas of seagrass highlighted in green. Image by Jiwei Li/ASU

Text image(s)

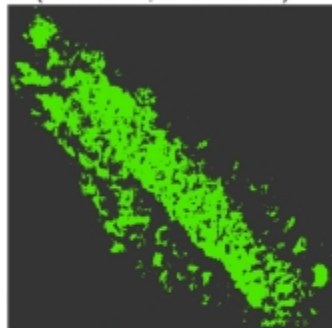
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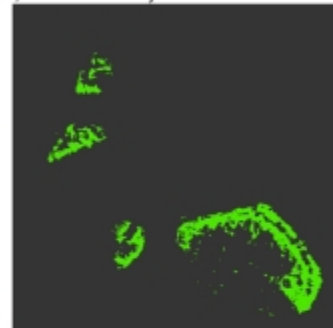
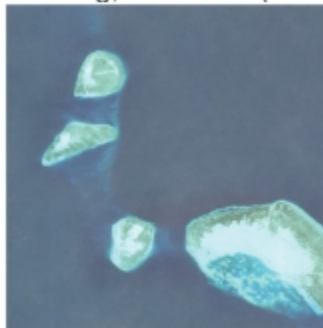
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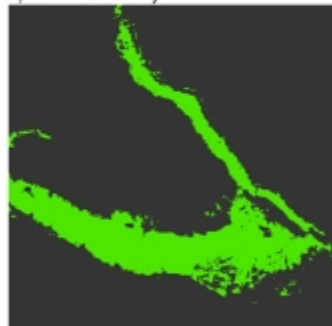
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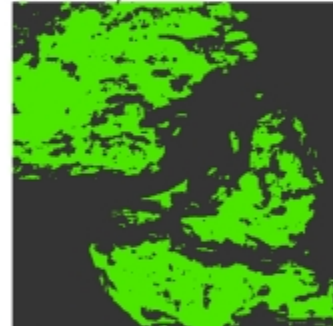
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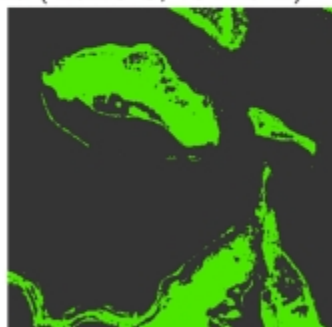
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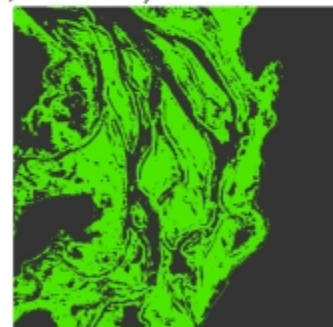
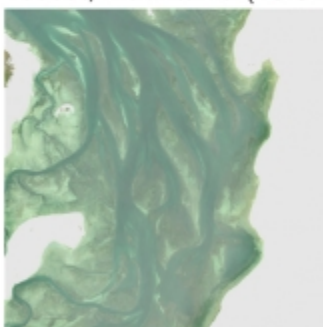
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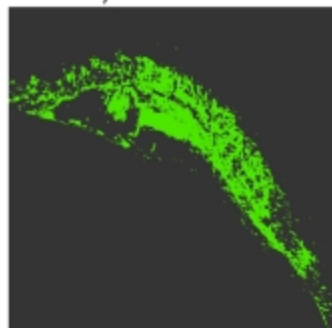
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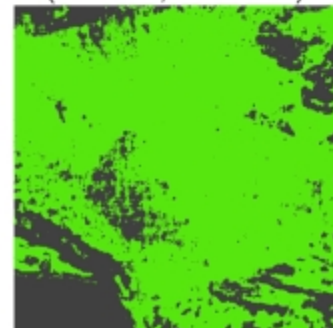
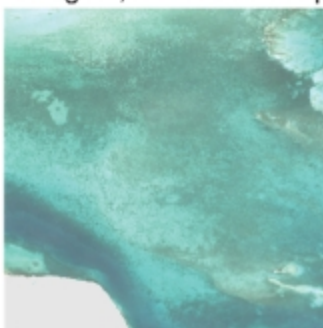
Tessot, Mauritania (19.81°N, -16.29°W)



Mossoro, Brazil (-4.70°S, -37.34°W)



El Algibe, Dominican Republic (18.19°N, -68.66°W)



Assistant Professor Jiwei Li's team trained an AI model to detect seagrass in satellite images, then used it to analyze millions of satellite images and create the global seagrass map. Pictured: This collection of satellite images shows the true color view on the left side and a map of that area's seagrass shown in green on the right. Image by Jiwei Li/ASU